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(71) Applicant *(for all designated States except US)*: TRYAM TRADING INC. [CA/CA]; 969 Derry Road East, Suite 102, Mississauga, Ontario L5T 2J7 (CA).

(72) Inventors; and
(75) Inventors/Applicants *(for US only)* : GROVES, Mark, William [CA/CA]; 40 Duggan Drive, Brampton, Ontario L6Y 4H9 (CA). SMITH, Michael, David [CA/CA]; 74 Rosebud, Brampton, Ontario L6X 2W5 (CA). SMITH, Stephen, Robert [CA/CA]; 785 Willow Avenue, Milton, Ontario L9T 3E5 (CA).

(74) Agents: GALLOWAY, Warren, J. et al.; Du Pont Canada Inc., Box 2200 Streetsville, Mississauga, Ontario L5M 2H3 (CA).

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(57) Abstract

The present invention relates to an oil sorbent comprising a matrix of intermingled non-woven polyolefin fibres, shredded polyolefin film and cellulosic fibres. In preferred embodiments, the cellulosic fibres are wood pulp fibres, the polyolefin fibres are polypropylene fibres and the polyolefin film is polyethylene film. The invention also provides a process for the sorption of oil comprising the steps of contacting the oil with a sorbent, said sorbent comprising a matrix of intermingled non-woven polyolefin fibres, shredded polyolefin film and cellulosic fibres. The oil sorbent is useful for recovery of oil, especially hydrocarbon oil, from oil spillages, especially spillages into water.

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OIL SORBENT

The present invention relates to an oil sorbent formed from a matrix of intermingled non-woven polyolefin fibres, shredded polyolefin film and cellulosic fibres, which may be used for sorption of oil, especially hydrocarbon oil, and especially oil in admixtures of oil and water. The present invention also relates to re-use or recycling of oil and sorbent.

Concerns about the environment are of increasing social and political importance. Some of these concerns relate to the spillage of oil, particularly the spillage of oil into the oceans. A prime example of the latter was the accident in Alaska in which a large quantity of oil was discharged from a vessel. This resulted in a major environmental problem. The task of cleaning up the ocean in order to protect the environment was extremely difficult. While such environmental catastrophes do occur, other examples of spillage of oil, including oil into water, on a substantially smaller magnitude occur with relative frequency. Each spillage has an effect on the environment, and means to effectively remove the oil from the environment and hence protect the environment are important. In addition, spills occur in households and in industrial situations, which may or may not involve the presence of water but which potentially do involve the spillage of oil into the environment, and a need for disposal, re-use and/or recycling of oil and sorbent.

Methods for the segregation and recovery of oil from spillages are known. These methods include mechanical devices e.g. booms for containing oil in a restricted area and sweeping and skimming devices for removing oil from water; such methods tend to be less than satisfactory for cleaning up of oil spillages. The methods also include the use of a variety of organic matter, including peat, hemp, peanut shells and other

naturally occurring substances or materials derived from naturally occurring substances. In addition, materials formed from in particular polyolefins, e.g. fibres and foamed materials, are also known for use in recovery of oil in oil spillages.

The testing of a number of commercially available oil spill sorbents is described in "Selection Criteria and Laboratory Evaluation of Oil Spill Sorbents, Update III", Report EPS 3/SP/1 dated June 1985 from Environment Canada.

An oil sorbent material has now been found which is effective in the sorption of oil, especially admixtures of oil and aqueous liquids.

Accordingly, the present invention provides an oil sorbent comprising a matrix of intermingled non-woven polyolefin fibres, shredded polyolefin film and cellulosic fibres.

In a preferred embodiment of the present invention, the cellulosic fibres are wood pulp fibres and preferably constitute less than 10% of the oil sorbent.

In a further embodiment the polyolefin fibres are polypropylene fibres and the polyolefin film is polyethylene film.

In another embodiment, the oil sorbent contains sufficient adhesive material to prevent the formation of fines.

The present invention further provides a process for the sorption of oil comprising the steps of contacting the oil with a sorbent, said sorbent comprising a matrix of intermingled non-woven polyolefin fibres, shredded polyolefin film and cellulosic fibres.

In a preferred embodiment of the process of the invention, the oil is a hydrocarbon oil.

In another embodiment of the process, the oil is in the form of an admixture with water, and preferably the

process involves sorption of oil from the water and recovery of the oil from the sorbent.

The oil sorbent is comprised of a matrix of intermingled non-woven polyolefin fibres, shredded polyolefin film and cellulosic fibres. The polyolefin fibres may be polyethylene fibres or, preferably polypropylene fibres. The polyolefin fibres may comprise 20-80% by weight of the sorbent, especially 30-70% by weight but preferably comprise the major portion of the oil sorbent, i.e. greater than 50% by weight of the oil sorbent. The polyolefin fibres are non-woven fibres and may in fact be in the form of pulp or other mass of fibres. While the individual fibres may be of significant length, in preferred embodiments the fibres are relatively short and random in length. There is a natural affinity of hydrocarbon oil for polyolefins; the ability of the polyolefin for sorption of oil appears to be a function of the surface area of the polyolefin and the particular nature of that surface. While it is not necessary to do so, the polyolefin fibres could have coatings of oil sorbing materials or agents that wet the surface of the fibre with respect to oil and promote sorption of oil.

The cellulosic fibres are preferably wood pulp fibres and constitute 0.5-25% by weight of the oil sorbent, especially less than about 10% by weight of the oil sorbent, and particularly about 5 to 10% by weight. The cellulosic fibres are relatively short fibres with a high surface area.

The polyolefin film is a shredded film. The film may have been shredded in a wide variety of shredders, including water jet cutters, serrated or rotating knives, blades shears or other rotary cutting, shredding or granulating devices. The film in shredded form is preferably of a size that is less than of about 15mm in its largest dimension, especially less than about 5mm and

particularly less than about 3mm. The amount of polyolefin film is the complement of the other components, and thus is in amounts of about 19.5-79.5% by weight, with preferred amounts being 30-70% by weight. The polyolefin film may be a polypropylene film but is preferably a polyethylene film, including polyethylene film that has been formed from copolymers of ethylene and minor amounts of higher alpha-olefins e.g. butene-1, hexene-1 or octene-1; the polyolefin film may contain fillers e.g. starch-based fillers and/or be blended or coated with other polymers e.g. polyvinyl alcohol or ethylene/vinyl alcohol copolymers.

The shredded polyolefin film also acts as an sorbent for the oil. However, it is believed that the polyolefin film has another more important function which is to create voids within the matrix of intermingled polyolefin fibres, thereby facilitating the migration or wicking of oil within the matrix of the polyolefin fibres. The random shape and size of the individual pieces of shredded polyolefin film tends to disrupt the matrix of fibres and prevent the non-woven fibres from forming a dense mass, especially a dense mass that is substantially oil impenetratable. Even if the oil sorbent should be compacted e.g. by mechanical means for shipping or storage, the shredded polyolefin film tends to reestablish a matrix of polyolefin fibres with voids therein to permit oil to access the surface of the fibres after the compacting forces have been removed.

It is believed that the polyolefin fibres and the polyolefin film are effective in sorbing substantial quantities of oil from a surface. However, it is also understood that such fibres and film are less effective in removing surface layers of film from a surface. However, the cellulosic fibres, especially wood pulp fibres, in the oil sorbent in the present invention are

believed to come into more intimate contact with those surfaces and facilitate removal of oil therefrom.

In preferred embodiments of the invention, the oil sorbent has a minor amount of adhesive material forming part of the oil sorbent. The adhesive material and inherent electrostatic or related attractions should be sufficient to attach the cellulosic fibres to the remainder of the matrix to an extent that the integrity of the matrix is improved by binding the "fines" in the oil sorbent. A substantial proportion of those fibres should, however, be free of the surface, and therefore capable of contacting oil and acting as an sorbent. Prevention of the formation of fines in the oil sorbent is important as the fines would tend to fall from the oil sorbent and remain on the surface that is to be cleaned, making the cleaning less efficient. The adhesive thus improves the handling characteristics of the oil sorbent.

A preferred source of the oil sorbent of the present invention is from the plastic material obtained from the process for the treatment of absorbent sanitary paper products that is disclosed in the copending PCT patent application of Marlene E. Conway, François Jooste and Michael D. Smith filed concurrently herewith. Such plastic material would normally need to be comminuted prior to use as an oil sorbent.

The oil sorbent tends to float on water, which facilitates the separation of the oil sorbent containing sorbed oil from water. For example, the oil sorbent containing oil may in many instances be merely picked up from the surface of the water using scoops or related devices. A substantial portion of the oil may be removed from the oil sorbent by mechanical means e.g. by squeezing the oil sorbent between rollers, by centrifugal extraction or by other means.

The oil sorbent of the present invention may be compressed for shipping and storage, thereby permitting

storage of a considerable amount of oil sorbent in a relatively small space. On release of the compressive forces e.g. on distributing the oil sorbent on a surface, the sorbent reverts to a larger volume, especially a volume substantially similar to that prior to compaction. The oil sorbent is readily removable from water and tends to clean up not only large pools of oil but also oil that is on the surface of substrates.

While the sorbent has been described herein as being comprised of polyolefin fibres, shredded polyolefin film and cellulosic fibres, it is to be understood that the sorbent may also contain other materials, depending in particular on the origin of the sorbent. In particular, oil sorbent obtained from the process of the aforementioned PCT patent application of Marlene E. Conway et al may contain super absorbent polymer, adhesives, tape tabs, spandex (Lycra™) and other material; such additional materials would normally be in relatively small proportions compared with the polyolefin fibres and film.

The sorbent may be used in recovery of oil, especially hydrocarbon oil, from oil spillages, including recovery of oil from oil spillages into water. However, the oil sorbent may be of more significant use in industrial situations e.g. on the floors of metal and machine shops, at gasoline and oil filling stations e.g. in adjacent ditches or in the water near marinas or ocean loading and unloading locations. The oil sorbent may also be useful in treating wildlife that has come into contact with oil spillages, by placing the wildlife directly in contact with the oil sorbent; such treatment of wildlife especially water birds should have a substantially greater likelihood of success than washing the wildlife with detergent solutions that has been used heretofore. The oil sorbent is believed to be especially

useful for spillages of light-medium grades of refined or crude oil.

The present invention is illustrated by the following examples.

Example I

A series of samples of polyolefin fibre, shredded polyolefin film and cellulosic fibres were contacted with oil. In each instance, the oil was a clean 10W40 motor oil. The samples had been obtained from product obtained in a process for the treatment of absorbent sanitary paper products, specifically soiled diapers, of the type described in the aforementioned PCT patent application of Marlene E. Conway et al. The procedures and results obtained were as follows:

(a) A sample containing approximately 55% of polyolefin fibre, 40% of shredded polyolefin film and 5% of cellulosic fibre was weighed and then soaked in the motor oil. The sample was then removed from the motor oil, allowed to drain for a period of two minutes and re-weighed. It was found that the sample had sorbed 6.6 times its weight in oil.

(b) A sample containing approximately 60% of polyolefin fibre, 30% of shredded polyolefin film and 10% of cellulosic fibre was weighed and then soaked in the motor oil. The sample was then removed from the motor oil, allowed to drain for a period of two minutes and re-weighed. It was found that the sample had sorbed 7.1 times its weight in oil.

(c) A sample containing approximately 40% of polyolefin fibre, 55% of shredded polyolefin film and 5% of cellulosic fibre was weighed and then soaked in the motor oil. The sample was then removed from the motor oil, allowed to drain for a period of two minutes and re-weighed. It was found that the sample had sorbed 5.5 times its weight in oil.

None of the samples contained water.

The results show that oil sorbent of the type described in the present application is capable of sorbing up to in excess of 7 times its weight in oil, especially 5-7 g/g of oil. The oil sorbent is a low cost material, clean, relatively lint free, compactable and light weight.

Example II

A random sample of an oil sorbent as described herein, obtained from the aforementioned process of Marlene E. Conway et al, was used to test the recovery of oil from water.

A quantity of 10W40 motor oil was poured onto water in a shallow container. The sample of oil sorbent was placed in the container and gently admixed with the oil and water.

After a few minutes, a mass of oil and oil sorbent was floating on top of the water. This mass was readily removed with a tyned scoop (fork). Essentially all of the oil had been recovered from the water. Oil could be squeezed from the mass of oil and sorbent.

CLAIMS:

1. An oil sorbent comprising a matrix of intermingled non-woven polyolefin fibres, shredded polyolefin film and cellulosic fibres.

2. The oil sorbent of Claim 1 in which the cellulosic fibres are wood pulp fibres.

3. The oil sorbent of Claim 1 or Claim 2 in which the cellulosic fibres constitute less than 10% of the oil sorbent.

4. The oil sorbent of any one of Claims 1-3 in which the oil sorbent contains sufficient adhesive material to prevent the formation of fines.

5. The oil sorbent of any one of Claims 1-4 in which the polyolefin fibres are polypropylene fibres and the polyolefin film is polyethylene film.

6. A process for the sorption of oil comprising the steps of contacting the oil with a sorbent, said sorbent comprising a matrix of intermingled non-woven polyolefin fibres, shredded polyolefin film and cellulosic fibres.

7. The process of Claim 6 in which the oil is a hydrocarbon oil.

8. The process of Claim 6 or Claim 7 in which the oil is in the form of an admixture with water.

9. The process of Claim 8 in which sorbent containing sorbed oil is separated from the water, and oil is recovered from the sorbent.